MODULE

BSEN40520 Optical Sensing Technology

MODULE OBJECTIVES

This module is designed for students who wish to understand and become critically aware of the basic principles, practice and applications of optical spectroscopic sensing. The fundamentals of visible, near infrared and mid-infrared spectroscopy will be presented. Standard approaches and configurations for acquisition and analysis of spectral and spatial data will be covered. Spectral pre-processing methods and methods of data selection will be introduced. Chemometric tools such as Principal components analysis for optical data analysis will be presented.

Learning Outcomes:

On completion of this module students should be able to:

1. Understand the basic principles of light-matter interaction at different wavelength ranges and spatial scales
2. Compare spectral responses of materials using a range of optical spectroscopic techniques
3. Analyse and interpret spectral data using MATLAB

Student Effort Hours:

Hours Lectures	**24**
Autonomous Student Learning	96
Total	120

Approaches to Teaching and Learning:

active/task-based learning; peer and group work; lectures; enquiry & problem-based learning

EXAMPLE OF SESION PLAN

Title: Uv-Vis **Duration:** 2h	**Module: BSEN 40520**	**Number in Sequence: 1** **Type of class: Presential**

Aim(s): Introduce UV-Vis spectrometry – fundamental basis, operation, spectrometer design

Outcomes: At the end of this lesson the students should be able to
Understand fundamentals of electromagnetic spectrum wave/particle theory
Identify spectra of various colors
Make a basic calibration curve and predict concentration of unknown.
Relate the components of a spectrometer

Time and objectives	Teacher Activity	Student Activity
0h **0-5 min** *Provide context*	Short class intro	Introduce themselves: name, where you were born, degree program
0h **5-10 min** *Provide context and content*	*Module intro:* structure, timetable, assessments	Listen
0h **10-15 min** *Engagement with the class, feedback from the class*	Give out post-its and ask the students to write 2 points on what they hope to gain from this course. Put post-its on the board, discuss.	Write on post its, listen
0h **15-45 min** *Provide context and content.*	Intro lecture on electromagnetic spectrum wave/particle theory, UV vis spectra Beer's law	Listen, ask questions
0h **45- 60 min (flexible time/ activities)** *Feedback to check learning.* *Learning by exploration.*	Display three visible absorbance spectra. Each spectrum corresponds to one color Guess the correspondence- *Socrative.* Discuss the answers – why certain colors have certain spectra Demonstrate Matlab interactive tool, spectra of different points of a color chart image.	Participate via mobile phone Participate in open class discussion. Observe. Download the tool. Test spectra of colors on different points of the image
0h **45- 60 min (flexible time/ activities)** *Provide context. Promote engagement with the subject. Promote creative thinking.*	Propose *Brainstorming* on possible applications for spectroscopy.	Write it on *Jamboard* (*Jamboard* to be discussed at the end of the class)

1h 0 - 5 min	Class break

Time	Teacher Activity	Student Activity
1h **5-20 min** *Provide context and content*	Concept of lamba max Beer Lambert Law Calibration curves – how to do them	Observe, take notes
1h **20-30 min** *Learning by doing*	Calibration curve task	Group work (*Syndicates*). Calculate calibration curve in excel, given data.
1h **30 - 35 min** *Provide feedback*	Go over calibration curve	Listen
1h **35 - 50 min** *Provide context and content*	Lecture on spectroscopy instrumentation, types of and components	Listen Explore Newton prism, portable spectrometer, other components
1h **50-60 min** *Provide feedback and promote class participation. Opportunity for inclusive universal learning (different platforms*). *Encourage peer learning and interaction. Getting students to articulate their ideas. Feedforward for a graded course assignment.*	Review Jam board applications for spectroscopy. Propose task (non-graded): Choose one spectroscopy application and prepare a 3-minute pitch ("*Three Minutes Each Way*" approach), an A3 graphic poster, a short video (*TikTok* type) or a 300 words summary about one spectroscopy application to display it on next class. This theme will be used later on for a graded assignment.	*Fishbowl*. Discuss brainstorm answers on *Jamboard* Listen, take notes

Materials needed:
Post-its
PPT1 – Intro lecture , PPT2- spectroscopy instrumentation
Demonstration material: Newton prism, cardboard slits, plastic diffraction gratings, other components.
Digital tools - Socrative Quizz, *Jamboard* set up, *Matlab* interactive tool for demonstration.
Students would need: smartphone for *Socrative* and *Jamboard* activities. Portable computer to calculate calibration curve and to test *Matlab* interactive tool by themselves during the class (1 computer per group of 3 students)